Palaeogeography, Palaeoclimatology, Palaeoecology 468 (2017) 122–128

Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

Overlapping paleoichnology, paleoecology and taphonomy: Analysis of tooth traces in a Late Pleistocene-early Holocene megafaunal assemblage of Brazil and description of a new ichnotaxon in hard substrate

Hermínio Ismael de Araújo-Júnior [a,*], Fernando Henrique de Souza Barbosa [b], Lucas Henrique Medeiros da Silva [c]

[a] Departamento de Estratigrafia e Paleontologia, Faculdade de Geologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier, 524, 20550-013, Maracanã, Rio de Janeiro, RJ, Brazil
[b] Programa de Pós-graduação em Geologia, Instituto de Geociências, Universidade Federal do Rio de Janeiro, Av. Athos da Silveira Ramos, 274, 21941-916, Cidade Universitária, Ilha do Fundão, Rio de Janeiro, RJ, Brazil
[c] Programa de Pós-graduação em Análise de Bacias e Faixas Móveis, Faculdade de Geologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier, 524, 20550-013, Maracanã, Rio de Janeiro, RJ, Brazil

ARTICLE INFO

Article history:
Received 15 March 2016
Received in revised form 1 December 2016
Accepted 11 December 2016
Available online xxxx

Keywords:
Ichnology
Taphonomy
Paleoecology
Machichnus
Megafauna
Tooth traces

ABSTRACT

Tooth traces are key evidence in vertebrate taphonomy, paleoecology and paleoichnology. They are product of feeding behavior of vertebrates and can also be evaluated in biostratinomic perspective. Regarding the Quaternary fossil record of vertebrates in Brazil, the taphonomic-paleoecological information of tooth traces has been underexplored. Recently, features of this sort were identified in Quaternary mammals fossils recovered from Lajedo da Escada caves, state of Rio Grande do Norte, northeastern Brazil, consisting in an opportunity to unveil taphonomic, paleoichnological and paleoecological aspects of the Quaternary megafauna. The ichnospecies *Machichnus bohemicus* and *M. fatimae* are recorded in the Late Pleistocene-early Holocene age. The latter is a new ichnospecies of *Machichnus* described herein. The traces *M. fatimae* and *M. bohemicus* observed in *Glyptotherium* sp. were generated outside the cave by an adult individual of the large-sized canid *Protocyon troglodytes* during event of predation. Nonetheless, *M. bohemicus* recognized in *Eremotherium laurillardi* and *Smilodon populator* was generated by either a juvenile individual of *P. troglodytes* or an adult of the small-sized canid *Cerdocyon thous*, in a scavenging context, outside the cave. Probably, other tooth traces previously reported to the Quaternary of Brazil (in the states of Ceará and Minas Gerais) can be assigned to *Machichnus*.

1. Introduction

Tooth traces are multidisciplinary evidence in Paleontology (Pirrone et al., 2014). They are a product of feeding behavior of vertebrates and can be generated during events of predation or even scavenging on a thanatocoenosis (Pobiner, 2008). Therefore, these features are a window into the knowledge of vertebrate taphonomy, paleoecology and ichnology (Bromley, 1996; Hone and Rauhut, 2010; Araújo-Júnior et al., 2011; Pirrone et al., 2014).

The taphonomic contribution of tooth traces lies on the opportunity of revealing the biostratinomic history of a fossil vertebrate assemblage, as these signatures are noteworthy evidence of scavenging. This process can remarkably influencing the preservation of a bone assemblage and then reflecting on the quality of the vertebrate fossil record (Behrensmeyer et al., 2000). Furthermore, tooth traces can be approached from the paleoichnological point of view by consisting of ichnofossils produced on bony substrate (Bromley, 1996; Buatois and Mángano, 2011; Pirrone et al., 2014). Thus, these signatures are useful to interpret the behavior of ancient vertebrates. Tooth marks can also be produced during predation and then analyzed on a paleoecological viewpoint (Blumenschine, 1986; Pobiner, 2008). Finally, these features can be translated into paleoenvironmental aspects, as they may be related to contexts of environmental stresses (Cutler et al., 1999). For all these reasons, tooth traces play a prominent role as evidence in vertebrate paleontology.

During the last decades, the Pleistocene Megafauna fossil record has played an important role for reconstructing paleoenvironmental, paleoecological and taphonomic scenarios of Brazilian Intertropical Region (BIR) (e.g. Cartelle, 1992, 1999; Bergqvist et al., 1997; Porpino et al., 2004; Oliveira et al., 2009; Dantas et al., 2005, 2011, 2013; Araújo-Júnior and Porpino, 2011; Araújo-Júnior et al., 2011, 2013, 2015). Yet, the taphonomic-paleoecological information of tooth traces has been underexplored (Araújo-Júnior et al., 2011) or even not been realized as a source of information. Recently, these features were identified in Pleistocene mammal remains recovered from a cave system in northeastern Brazil. Thus, this is an opportunity to explore

* Corresponding author.
E-mail addresses: herminio.ismael@yahoo.com.br (H.I. Araújo-Júnior), fhsbarbosa@gmail.com (F.H.S. Barbosa), lucashmsilva@hotmail.com (L.H.M. Silva).

http://dx.doi.org/10.1016/j.palaeo.2016.12.007
0031-0182/

taphonomic, paleoichnological and paleoecological aspects of the Pleistocene Megafauna fossil record of BIR.

Therefore, this work aims to describe these fossil traces and explore their potential in providing conclusions regarding: (1) the morphologies of the tooth traces and their possible producers; (2) the paleoecological/taphonomic context of their origin; (3) the ichnotaxonomic assignment of such ichnofossils; (4) the environmental phenomena that unleashed the behavior responsible for producing these signatures. Furthermore, a new ichnospecies is described herein.

2. Regional setting

The material was recovered from a cave system formed in limestones from the Upper Cretaceous Jandaíra Formation (Apodi Group, Potiguar Basin). The Jandaíra Formation limestones outcrop in several sites in the states of Rio Grande do Norte and Ceará, northeastern Brazil. During the Pleistocene, these rocks experienced intense karstification (Fig. 1), reflecting in the origin of several geomorphic structures on the landscape. Caves are the most prominent feature in this context (Fig. 1C).

The paleontological site consists of five caves developed in two karst pavements with total area around 5 km^2 (Fig. 1B), located at Lajedo da Escada site (LES; 5°11.114′S; 37°43.424′W). During the collection of the specimens (during the 1960′s), LES was located at Mossoró municipality (see Cabral-de-Carvalho et al., 1966), however, nowadays LES belongs to the Baraúna municipality (Fig. 1A), Rio Grande do Norte State, Brazil.

Generally, the caves are filled by fine sediments and bioclasts belonging to megamammals, mid-sized mammals, small-sized mammals, reptiles and avians. Their fossil assemblage has been widely evaluated in terms of taxonomy (Cabral-de-Carvalho et al., 1966; Damasceno, 1973) and paleopathology (Barbosa et al., 2014). Although underexplored geochronologically, the taphocoenosis has been attributed to the Late Pleistocene (Cabral-de-Carvalho et al., 1966; Damasceno, 1973; Barbosa et al., 2014). However, numerical datings recently obtained using megafaunal specimens from other BIR deposits have pointed to the Late Pleistocene-early Holocene age (Silva, 2008; Dantas et al., 2013; Ribeiro et al., 2014). Here we follow these recent datings and assign the Late Pleistocene-early Holocene age for LES assemblage.

3. Material and methods

The dataset consists of 832 specimens, including cranial and postcranial elements assigned to megamammals (>1000 kg) and large-sized mammals (100–1000 kg). We performed a previous screening in order to sort the tooth-marked specimens, then, only five ones were analyzed (0.6% of the total sample). The fossils are housed in the "Onofre Lopes" Vertebrate Paleontology collection of Museu Câmara Cascudo, Universidade Federal do Rio Grande do Norte (MCC/UFRN), in Natal (state of Rio Grande do Norte, Brazil) and are labeled as MCC 242-V, MCC 411-V, MCC 476-V, MCC 482-V and MCC 491-V. Macroscopical and microscopical observations were performed in this study. The latter was carried out using magnification lens in a stereo microscope Zeiss Stereo Discovery.V12.

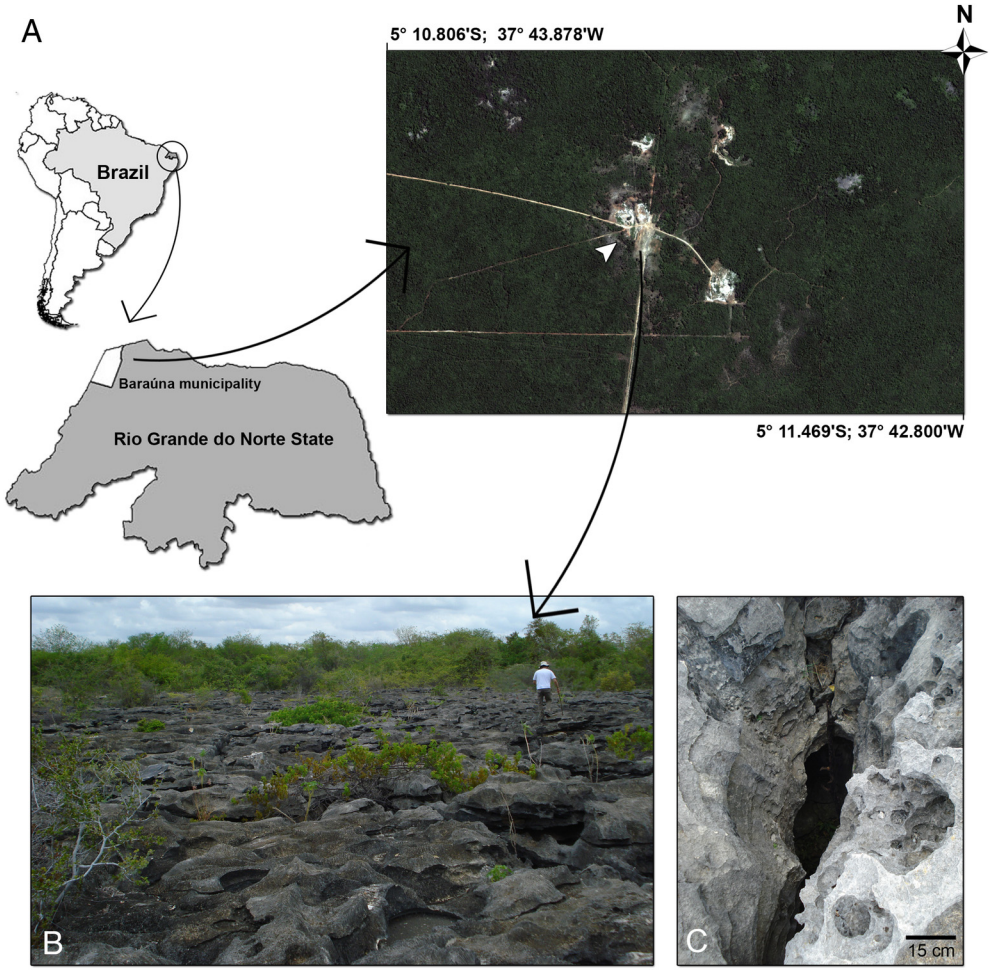

Fig. 1. Geographic location and geologic aspects of Lajedo da Escada Paleontological Site (LES). A. Location of Lajedo da Escada Paleontological Site; B. Panoramic view of the main karst pavement of the Upper Cretaceous Jandaíra Formation (Potiguar Basin), where the caves were formed; C. Entrance of a fossiliferous cave of LES.